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Mathematical modelling of MSW incineration in a packed bed

Guanyi Chen[1,2], Tianbao Gu[1] , Xiao He[1], Chungen Yin[3,*] , Wenchao Ma[1,*], Beibei Yan[1] , Li'an Hou[1,4]

[1]*School of Environmental Science and Engineering/State Key Lab of Engines, Tianjin University, Tianjin 300072, China*
E-mail: mawc916@tju.edu.cn
[2]*School of Science, Tibet University, Lhasa 850012, Tibet Autonomous Region, China*
[3]*Institute of Energy Technology, Aalborg University, DK-9220 Aalborg East, Denmark*
E-mail:chy@et.aau.dk
[4]*The Second Artillery Engineering University, Xi'an 710025, PR China*

Abstract: Grate-firing is the most commonly used technology for municipal solid waste (MSW) incineration for heat and power generation, in which MSW undergoes thermochemical conversion (e.g., drying, devolatilization, char gasification and oxidation) in the fuel bed on the grate while the combustible gases and the entrained fine particles are further burned in the freeboard. Nevertheless, grate-firing generally needs to be improved in terms of efficiency and overall environmental impacts, in which computational fluid dynamics (CFD) modelling plays the vital role. In this paper, a comprehensive mathematical model is developed to simulate MSW incineration in a packed bed which is subject to the heating source on the bed top and the primary air flow at the bed bottom. The entire fuel bed is discretized into a number of control volumes. In each of the control volumes, the transport equations for mass, momentum, energy and individual species, which fully address the MSW thermochemical conversion (including trace elements), as well as heat and mass transfer are numerically solved by using the finite volume method(FVM). The model is verified by comparing the predictions against the experimental results of MSW incineration in a packed bed under given condition available in the literature. After appropriate extension, the model will be used for MSW incineration in the fuel bed in a real MSW-fired grate boiler, aiding CFD-based design and operation optimization for the boiler.

***Keywords*:** MSW incineration, CFD, thermochemical conversion, FVM